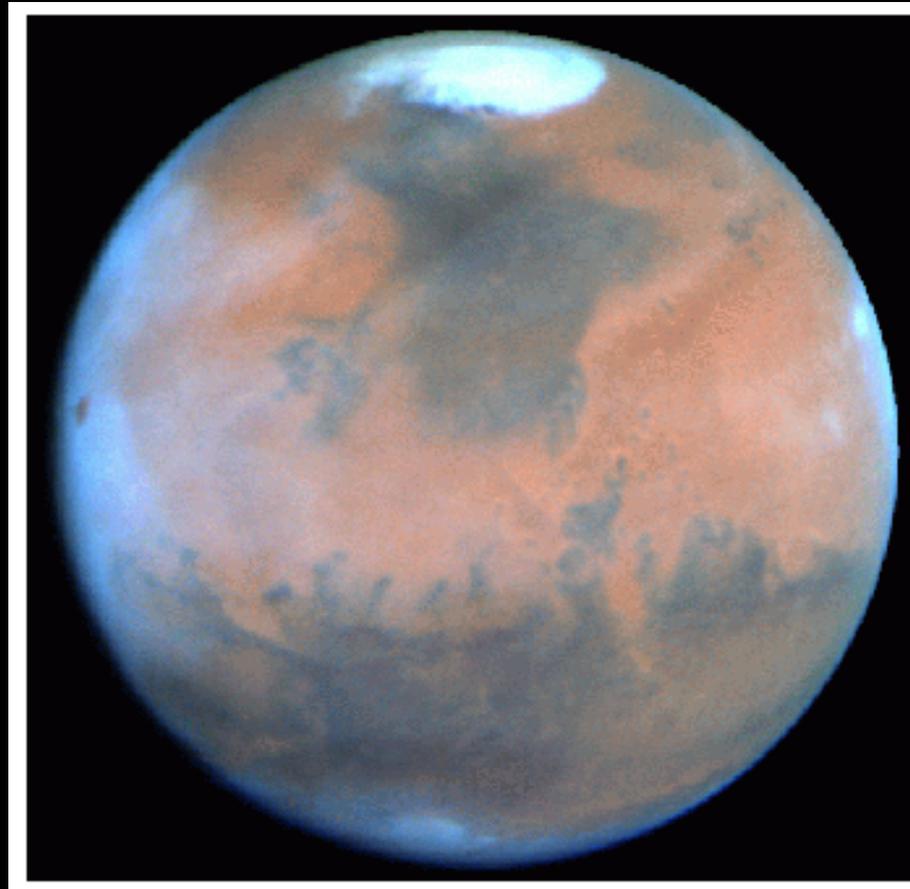


LMD-CNRS

AOPP

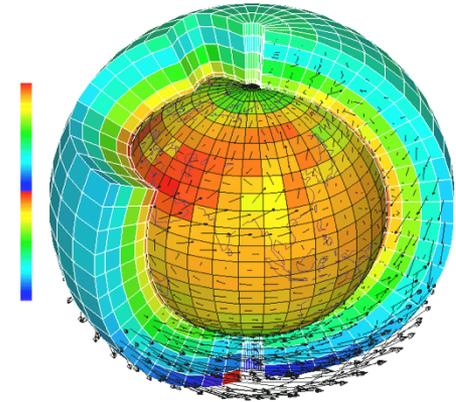
CNES

ESA



**A model based Mars Climate
Database for Mission design:**

Why a model based climate database ?



- ❑ The Martian environment is highly variable
- ❑ Observations coverage is far from complete:
 - mostly temperature profiles up to 60 km, many with coarse vertical resolution (TES)
 - limited local time coverage
 - a few in situ observations
- ❑ GCMs (Mars General Circulation Models = Global Climate Models) can predict main aspects of the observations

➔ Models can be used to extrapolate the observations

Mars Climate Database v3.1

Who uses it ? (~60 users !)

□ Data analysis :

- **Mars Express** : PFS data inversion (IFSI), **Spicam** (SA), **Omega** (LESIA, LPG)
- **Mars Odyssey GRS** (LPL), **Infrared Space Observatory** (LESIA, IKI), **Phobos 2 ISM** (IAS, LESIA), **MGS Mars Odyssey accelerometer** (NASA Langley), **ISO** (LESIA-IKI), **Anglo-australian Observatory**

□ Mission design

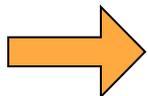
- **MSL** (JPL), Study for **Aurora** program (Astrium UK, CEA, Graz University of Technology, Alenia)
- **Beagle 2** (Open University, Martin Baker Aircraft Ltd, DLR), **Mars Express** (Astrium, ESTEC), **Netlander** (CNES, Alcatel, CEA, Babakin, Astrium, OHB-System, Institut fuer Planetologie, Münster), Entry study (Surrey Space Centre, Canadian Space Agency, Mars Horizon project)

□ Instrument design:

- **PFS Mars Express** (IFSI, Observatory of Capodimonte), **Neige-Netlander**, **Mars Atmosphere Microwave sounder**

□ Science studies:

- **Isotope cycle** (NCP, Canada), (**Mesoscale model** (University of Helsinki), **Geodesy** (JPL, Royal Observatory of Belgium), **Wave analysis** (University of Boulder), **Photochemistry** (Centro de astrobiologia)



New release MCD v4.0

The new Mars Climate database MCD v4.0

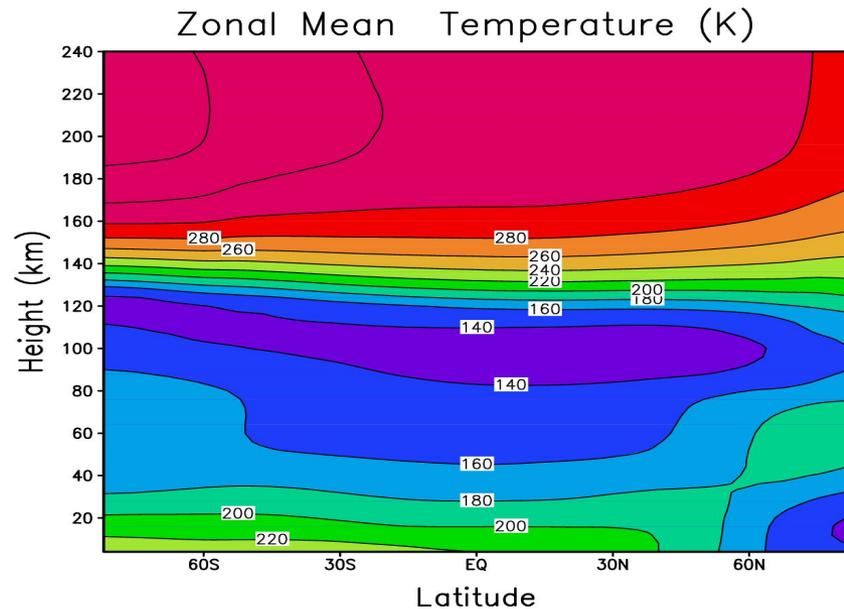
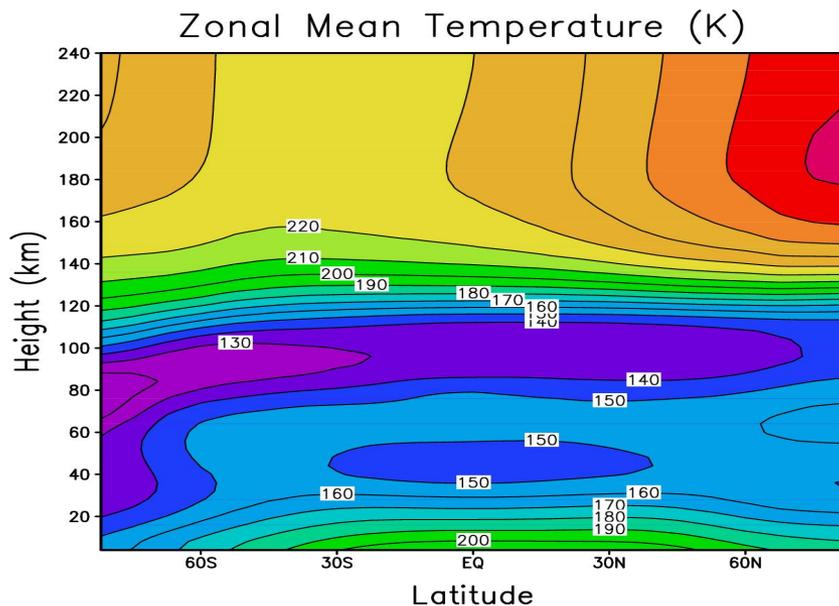
MCD v4.0: what's new ? 1/3

Extension to the thermosphere: up to 250 km

Monica Angelats i Coll

Above 100 km database v4.0 will also include 3 scenarios to describe solar cycle (Extreme UV input) : “solar mean”, “solar maximum”, “solar minimum”

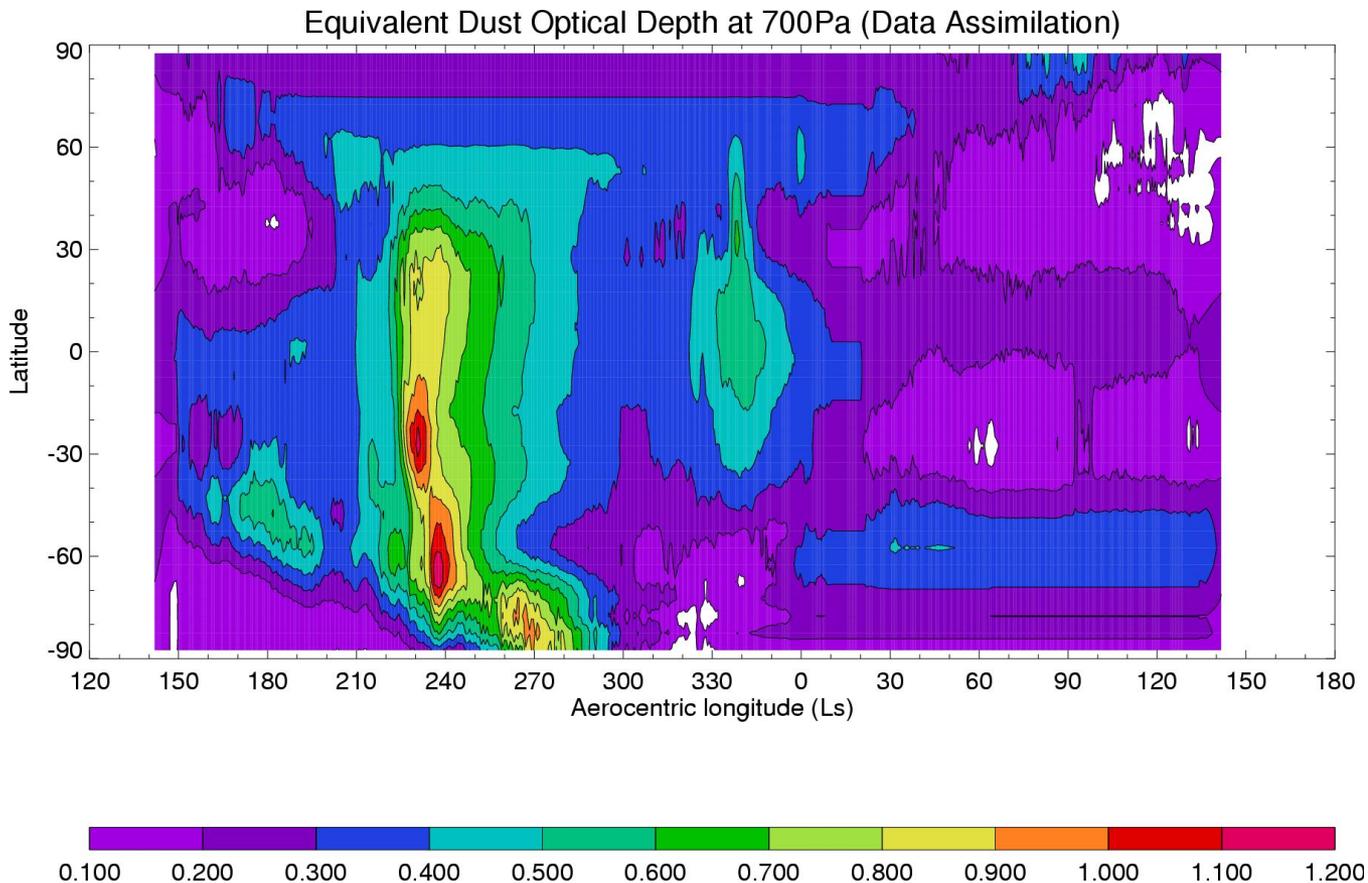
Use of hybrid coordinates



MCD v4.0: what's new ? 2/3

New dust scenario to represent the dust variability

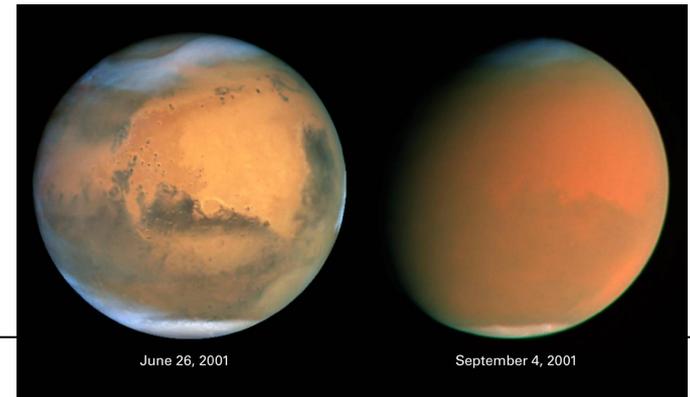
- ❑ "Best" dust scenario (Scenario « **MY24** » based on assimilation) topped by 3 solar EUV conditions: solar min, solar mean, solar max



MCD v4.0: what's new ? 2/3

New dust scenario to represent the dust variability

- ❑ **"Best" dust scenario** (Scenario « **MY24** » based on assimilation) topped by 3 solar EUV conditions: solar min, solar mean, solar max
- ❑ **One dust storm scenario** (Constant visible optical depth = 3) for 6 seasons from Ls=180 to Ls=360 (season 7 to 12) topped with 3 solar EUV conditions: solar min, solar mean, solar max
- ❑ **Warm scenario** : our traditional "Viking Lander dust scenario" + topped with a solar max thermosphere
- ❑ **Cold scenario** : our traditional "Low dust scenario" topped by a solar minimum scenario



MCD v4.0: what's new ? 3/3

Content : stored Variables

- ❑ **mean variables** (12 local times per season – 12 seasons)
 - temperature, surface pressure, winds, atmospheric density
 - atmosphere turbulent kinetic energy, CO2 ice cover
 - thermal and solar radiative fluxes
 - below 120km: **Dust mixing ratio**
 - below 120km: **[H2O] volume mixing ratio, H2O ice**
 - above 100km: **[O], [O2], [CO], [H], in volume mixing ratio**
 - above 100km: **Vertical wind**

- ❑ add **RMS** variables
 - **surface temperature, surface pressure, CO2 ice cover**
 - **temperature, winds, atmospheric density**

Simulation of Water ice clouds

Montmessin et al., LMD GCM

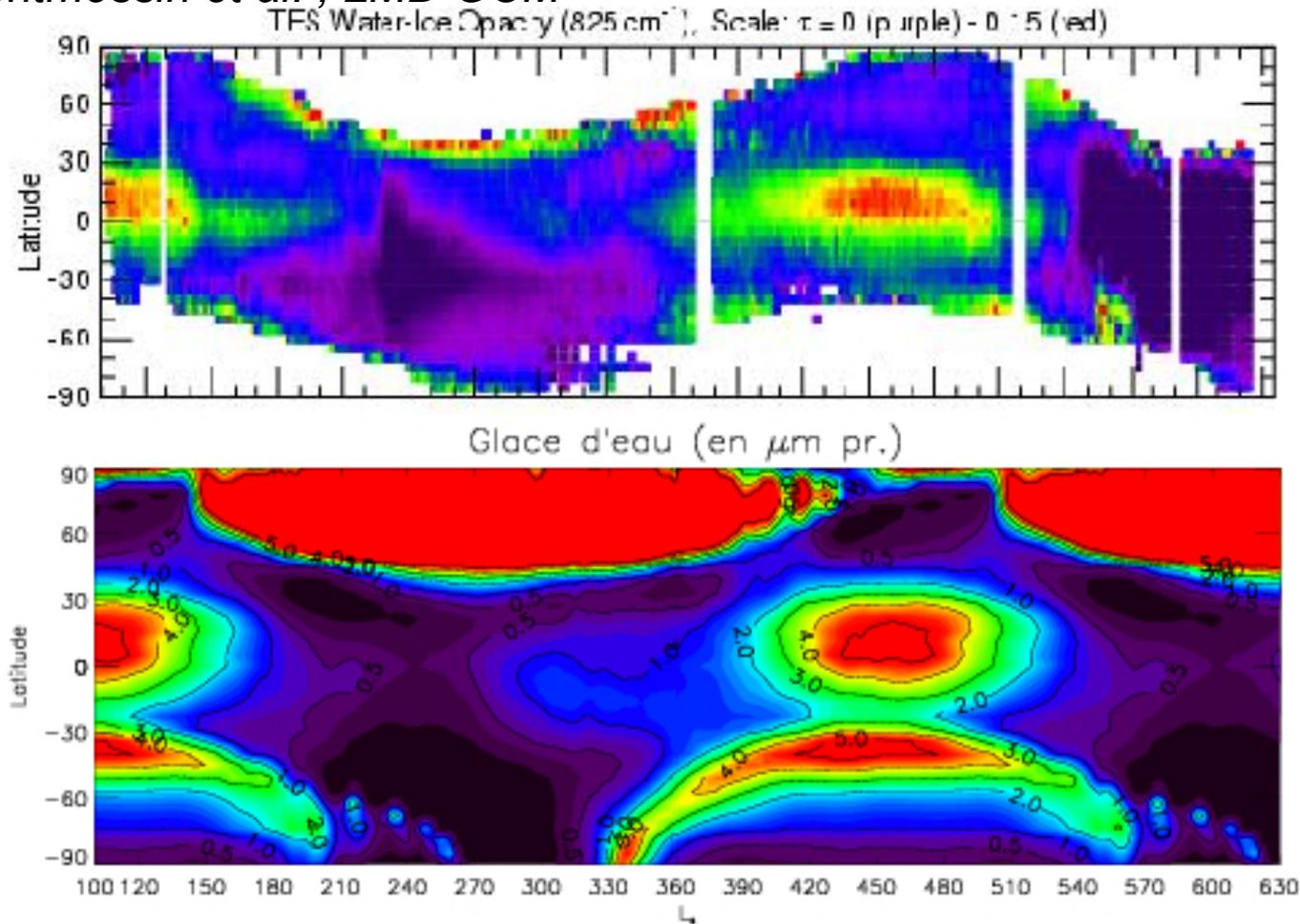
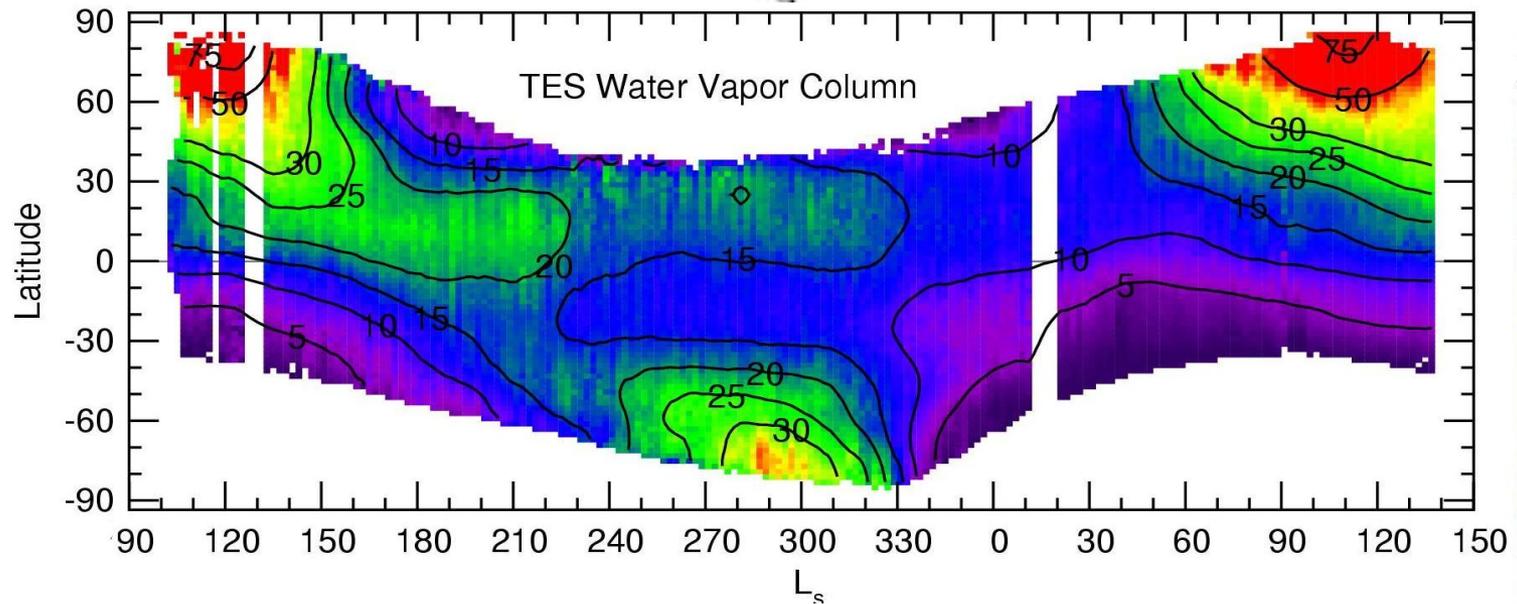
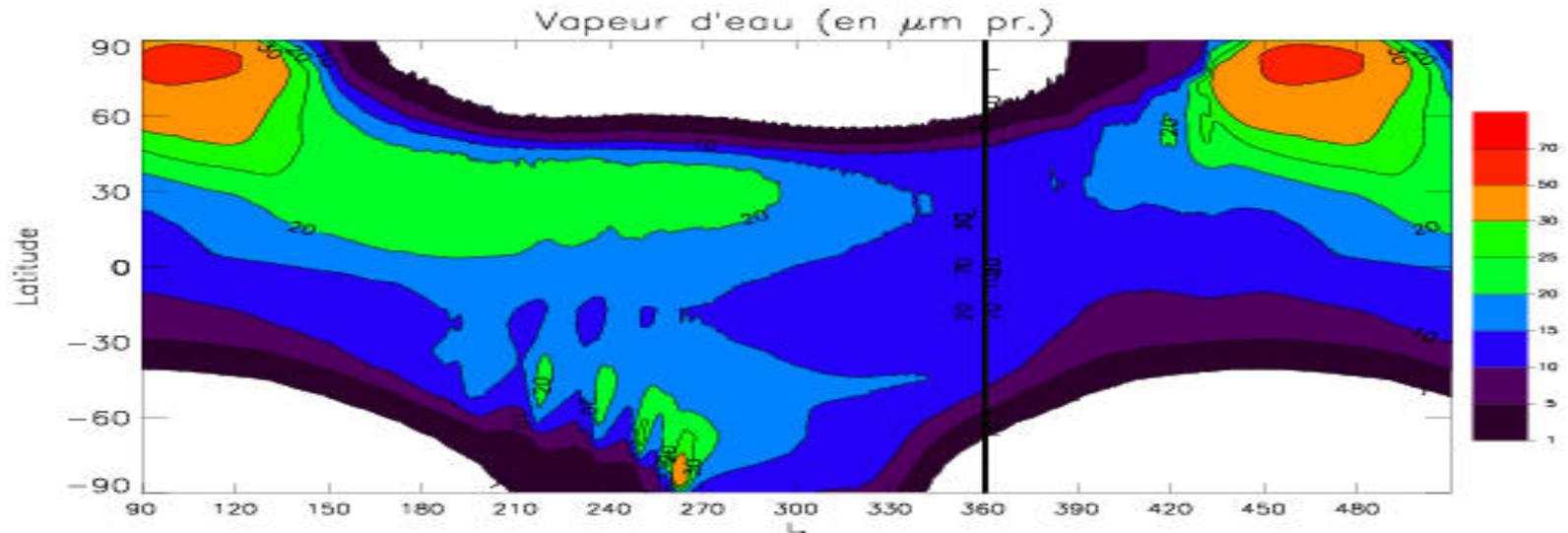


FIGURE 5.19 : Figure du haut : Variation temporelle et géographique de l'épaisseur optique des nuages de glace d'eau telle que déduite des mesures TES au nadir. Figure du bas : Distribution spatiale et saisonnière de la glace d'eau atmosphérique prédite par le modèle.

Simulation of Water ice cycle

Montmessin et al. , LMD GCM



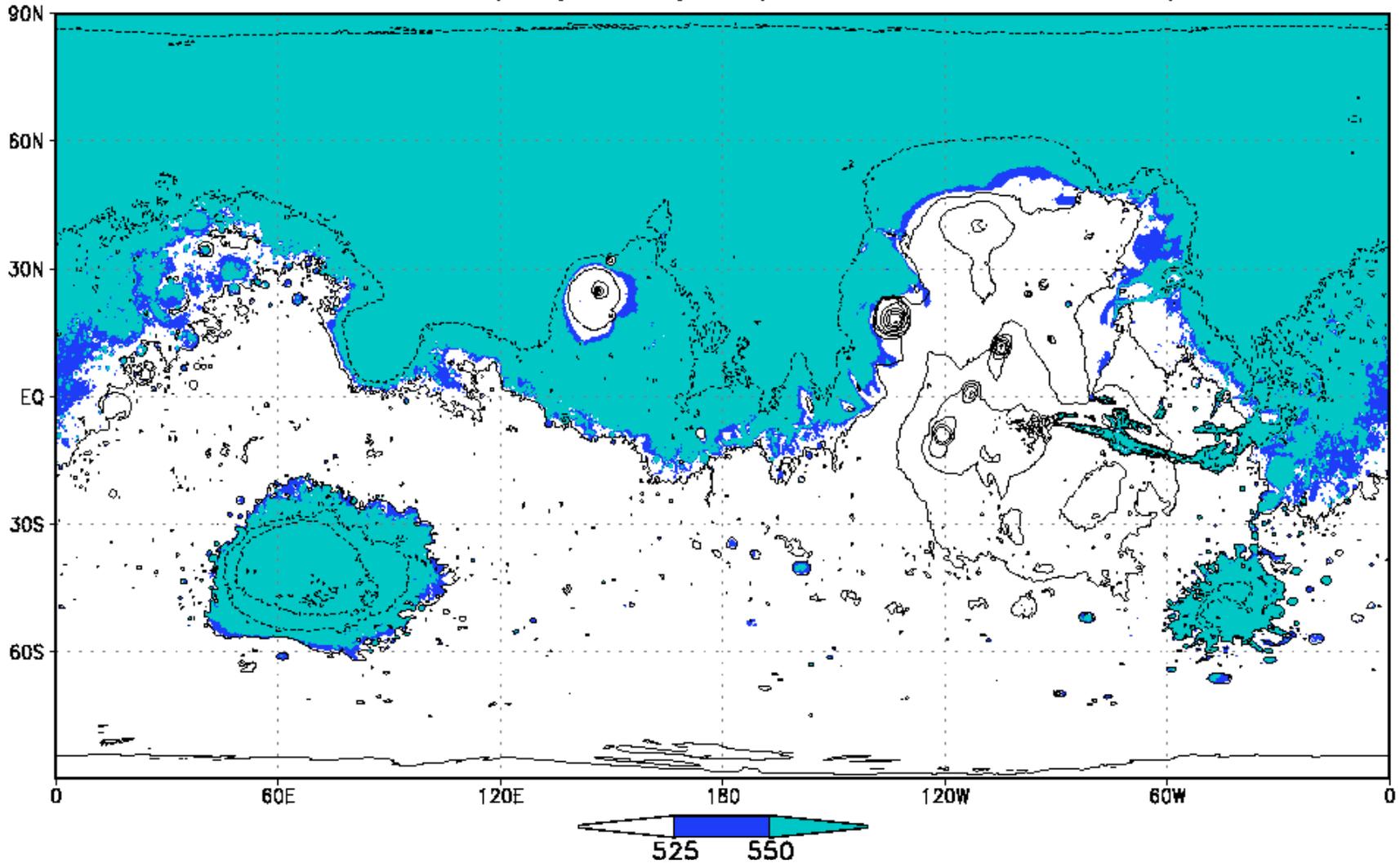
A new tool for surface pressure prediction

The best possible guess of surface pressure on Mars.

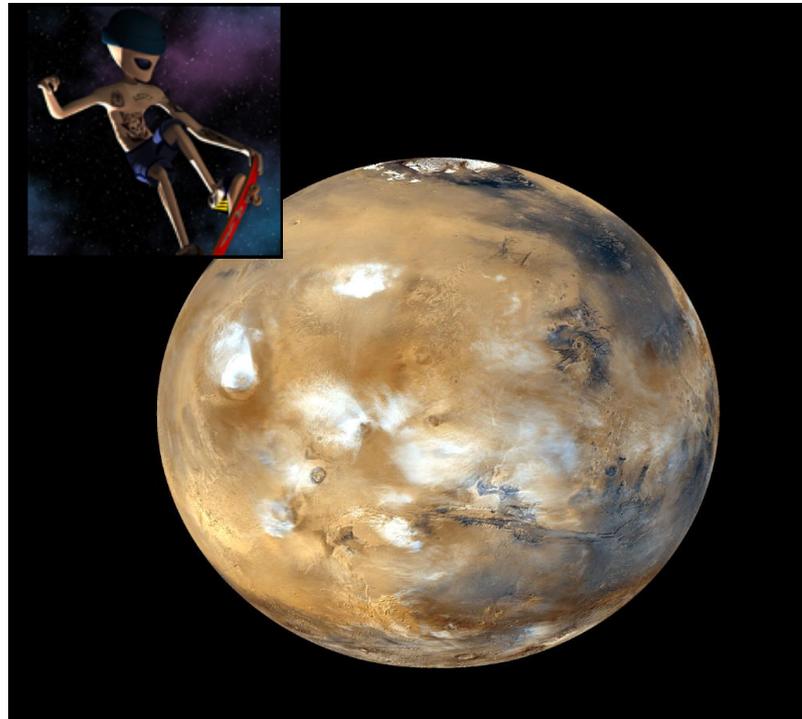
It combines:

- reference pressure measure of Viking lander 1 site at a given seasonal date.
- large scale spatial variation due to meteorology (including thermal tides at a given local time) from the GCM climate database.
- small scale variations due to topography, using 1/32 degree MOLA data

Diurnal Min Pressure (Pa) 22/09/2008, Ls=130.9 (LMD model)



Acces to the database MCD 4.0



How to access the database ?

- ❑ For intensive use (Fortran subroutines designed for Monte-Carlo re-entry studies):
 - MCD v3.1 on 2 CDroms provided with datafile (NetCDF) and softwares. ⇒ 60 copies currently used !!
 - MCD v4.0 on 1 DVDrom



Ask the LMD forget@lmd.jussieu.fr for copies of the database

- ❑ For moderate use : interactive web site :
<http://www-mars.lmd.jussieu.fr/>
same address for MCDv4.0

New web access

Live Access Server v6.2.1

- acces to all new variables, with all possible scenarios, up to 250km
- Vertical coordinate : altitude above areoid, pressure level, altitude above surface
- allow output comparaisons
- averages, min, max, sum, variances
- numerous output formats (gif, ps, text, netcdf, arcview gridded, ferret script, fortran formatted text...)

Delivery automn 2004

